Docket #: S07-132

MagSweeper: high purity capture of circulating tumor cells and other rare cells

An interdisciplinary team of Stanford researchers have developed MagSweeper, a patented robotic liquid biopsy device that efficiently isolates and purifies live CTCs (circulating tumor cells) from blood while removing 100% of contaminating blood cells. Downstream analysis of these cells can then be used to characterize the gene expression of metastases without an invasive biopsy. This device captures CTCs or other rare cells from a liquid sample using magnetic rods covered with removable plastic sleeves. These sleeves enable multiple capture and release cycles thereby assuring high purity and capture efficiency. For example, CTCs in patient blood samples (approximately 0-10 CTCs per 7.5cc tube) can be isolated with about 100% purity and 60% capture efficiency. In addition to capturing CTCs, MagSweeper could be used to isolate fetal stem cells or immune cells from fluid or tissue suspension samples.

Stage of Research
The inventors have demonstrated the utility of MagSweeper for isolating live CTCs from patient blood samples using the cancer-specific EpCAM protein as a biomarker. In that study, downstream analysis revealed the genetic diversity of CTCs.

Applications

- **Rare cell capture** - magnetic isolation of live cells with end-user applications such as:
    - liquid biopsy of CTCs from blood samples
    - fetal stem cell capture from cord blood
    - immune cell isolation from blood or tissue

Advantages

- **Efficient capture** - MagSweeper has approximately 60% capture efficiency for CTC cells (0-10 cells per 7.5cc tube)
- **High purity:**
  - approximately 100% pure target cells without blood cell contamination
  - number and stringency of washes can be controlled to ensure complete clearance of contamination
- **Live cells** - captured cells are viable with intact RNA for downstream expression studies

Publications

- Deng G, Krishnakumar S, Powell AA, Zhang H, Mindrinos MN, Telli ML, Davis RW, Jeffrey SS. Single cell mutational analysis of PIK3CA in circulating tumor cells and metastases in breast cancer reveals heterogeneity, discordance, and mutation persistence in cultured disseminated tumor cells from bone marrow. *BMC Cancer.* 2014 Jun 19;14:456.
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- Powell AA, Talasaz AH, Zhang H, Coram MA, Reddy A, Deng G, Telli ML, Advani RH, Carlson RW, Mollick JA, Sheth S, Kurian AW, Ford JM, Stockdale FE, Quake SR, Pease RF, Mindrinos MN, Bhanot G, Dairkee SH, Davis RW, Jeffrey SS. Single cell profiling of circulating tumor cells: transcriptional heterogeneity and diversity from breast cancer cell lines. *PLoS One.* 2012;7(5):e33788.
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- Talasaz, A. H., Powell, A. A., Huber, D. E., Berbee, J. G., Roh, K. H., Yu, W., ... & Jeffrey, S. S. (2009). Isolating highly enriched populations of circulating epithelial cells and other rare cells from blood using a magnetic sweeper device. *Proceedings of the National Academy of Sciences*, 106(10), 3970-3975.

- Surprising genetic diversity found in cells shed by tumors, *Inside Stanford Medicine*, May 21, 2012.

Patents

- Published Application: 20090220979
- Published Application: WO2009076560
- Published Application: 20120045828
- Issued: 8,071,395 (USA)
- Issued: 9,267,943 (USA)

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